system shall be specified in the contract documents.

621.10-METHOD OF MEASUREMENT:

Steel grid flooring will be measured by the number of square feet (meters) complete in place, not including Class A concrete. The volume of Class A Concrete will be computed on the basis of a slab equal to the thickness of the steel grid flooring as called for on the Plans, minus the volume of metal in the steel grid flooring. The volume of metal will be determined from the weight of the steel grid flooring as listed by the fabricator. The cost of construction of roadway drains, scuppers, downspouts, etc., where specified, shall be included in the price bid for Class A Concrete. The expansion devices will be included in the item of structural steel.

621.11-BASIS OF PAYMENT:

The quantities, determined as provided above, will be paid for at the contract unit price bid for the items listed below, which price and payment shall be full compensation for furnishing all the materials and doing all the work prescribed in a workmanlike and acceptable manner, including all labor, tools, equipment, supplies, and incidentals necessary to complete the work; except that Class A concrete will be paid for under Item 601001-*.

621.12-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
621001-*	STEEL GRID FLOORING, FILLED TYPE	FOOT (METER)
621002-*	STEEL GRID FLOORING, OPEN TYPE	FOOT (METER)

* Sequence number

SECTION 622
TIMBER BRIDGE STRUCTURES

622.1 - GENERAL:

622.1.1 - This work shall consist of the fabrication and erection or fabrication and delivery of timber bridge structures in accordance with these specifications and in reasonably close conformity with the lines, grades, dimensions and locations shown on the Plans. All work shall be done and all materials shall meet the requirements of this specification and plan notes.

622.1.2 - These specifications apply to the following types of timber bridge structures:

Type A: Longitudinal Stress-Laminated Plank Deck

The superstructure is formed by longitudinal vertical sawn lumber laminations which are clamped together on their wide faces by high-strength steel stressing thread bars through holes in the laminations. Stressing pressure is transferred to the timber by bearing plates located along the outer laminations at the edge of the deck and develops sufficient friction between the laminations

to cause them to perform structurally as a unit.

Type B: Cellular Structural Glued-Laminated Beams With Longitudinal Stress-Laminated Plank Deck

The superstructure is formed by longitudinal glued-laminatedbeams which are stress-laminated into two layers of longitudinal vertical sawn lumber laminations. One layer of vertical lumber is at the top surface of the glued-laminated beam and forms the deck. The second layer is at the bottom surface of the beam. The resulting cross-section is a closed cell box beam configuration.

Type C: Structural Glued-Laminated Beams With Longitudinal Stress-Laminated Plank Deck

The superstructure is a Tee cross-section formed by longitudinal glued-laminated beams which are stress-laminated with a layer of vertical sawn lumber to form the deck.

Type D: Structural Glued-Laminated Beams With Transverse Glued-Laminated Deck Panels

The superstructure consists of longitudinal glued-laminated beams with a non-composite transverse glued-laminated deck panels over the beams.

Type E: Structural Glued-Laminated Longitudinal Deck Panels With Transverse Glued-Laminated Stiffener Beams

The superstructure consists of longitudinal glued-laminated deck panels with transverse glued-laminated stiffener beams.

622.2 - MATERIALS:

622.2.1 - Stress-Laminated Plank Deck, Solid Sawn Curbs, Guardrail Posts and Guardrail: All structural lumber used in the bridge construction will be Northern Red Oak except when Structural Glued-Laminated Timber is specified on the Plans.

All lumber and timber shall be graded in accordance with the Standard Grading Rules for Northeastern Lumber, as published by the Northeastern Lumber Manufacturer's Association Incorporated (NELMA), 272 Tuttle Road, P.O. Box 87A, Cumberland Center, Maine 04021, Telephone # (207) 829-6901.

Lumber for stress-laminated plank decks shall be # 3 Grade or better except wane shall meet # 1 Grade, as specified in the above grading standards Section 20.0 for Structural Joists and Planks. Grading may be performed after rough sawing to approximate dimensions, however crook shall meet the grading rules after preservative treatment. Stress-laminated deck lumber shall be sawed, surfaced two sides (S2S), resawed or otherwise processed so that the resulting fit between adjacent planks will meet the applicable Manufacture-Standard as defined by the NELMA grading rules for the faces.

The thickness of planks shall be from 1 ½ inches (40 mm) through 2

inches (50 mm) with only one size to be used in a bridge deck. Stress-laminated deck lumber shall contain not less than 12% nor more than 19% moisture (oven dry basis) after preservative treatment and prior to fabrication. Moisture content is to be confirmed in accordance with AWPA A6, using a minimum sample size of 40 cores per lot of deck lumber taken at random throughout the lot. The length of each core sample shall be one-half the thickness of the deck plank.

Timber for guardrail posts and blockouts, curbs, curb blocks, and guardrail when specified on the Plans shall be "# 2 Grade" or better as specified in the above grading standards Section 25.0 for Beams and Stringers. Material may be rough saw cut to the approximate dimensions shown on the Plans so that after conditioning and preservative treatment the actual dimensions are within plus or minus 3/16 inch (5 mm) of plan cross sectional dimensions.

All lumber and timber shall be graded, approved and stamped or tagged by a lumber grader, certified by an agency who has been approved by The Board of Review of the American Lumber Standards Committee.

All dimensions shown on the Plans for structural lumber shall be actual dimensions.

When structural glued-laminated timber members are specified on the Plans they shall meet the requirements of Section 622.2.6.

622.2.2 - Timber Substructures: All beams, stringers, posts, timber and lumber for timber substructures shall be "# 2 Grade" or better Northern Red Oak as specified in the above grading standards Section 25.0 for Beams and Stringers, Section 26.0 for Posts and Timbers or Section 20.0 for Structural Joists and Planks as appropriate.

All beams, posts, timber, stringers and lumber shall be graded, approved and stamped or tagged by a lumber grader, certified by an agency who has been approved by The Board of Review of the American Lumber Standards Committee.

All dimensions shown on the Plans for structural beams, stringers, posts, timber and lumber shall be actual dimensions.

When structural glued-laminated timber members are specified on the Plans they shall meet the requirements of Section 622.2.6.

622.2.3 - Metal:

622.2.3.1 - Steel Products: Structural shapes, plates and bars (except steel thread bars and fabrication bars) shall meet the requirements of AASHTO M 270M Grade 250. Components requiring fabrication will be made in accordance with Section 615 of the Standard Specifications. Where welded fabrication is required, all work shall be in accordance with ANSI/AASHTO/AWS Bridge Welding Code D1.5. Nondestructive testing of welds is not required. All steel products shall be hot-dip galvanized, after fabrication to AASHTO M 111 except where otherwise noted. Properly documented certified mill test reports shall be provided for all above steel products. Certifications for hot-dip galvanizing shall be provided by the

galvanizing plant.

622.2.3.2 - Thread Bars: Steel thread bars shall be the size shown in the Plans and shall be designed to allow the use of anchor nuts and couplers that thread onto the deformations. Anchor nuts and couplers shall be of a design and material recommended by the thread bar manufacturer to develop the full tensile strength of the bar. Thread bars shall meet the following:

622.2.3.2.1: Steel thread bars shall be manufactured by a suitable process which will produce bars meeting the chemical, mechanical and physical requirements of AASHTO M 275M, Type II. Where 5/8 inch (15 mm) diameter nominal size bars are specified on the Plans, bars may be supplied to the following requirements in lieu of the above.

622.2.3.2.2: Alternate bars for 5/8 inch (15 mm) size shall meet the following TABLE:

Nominal Diameter (max.)	¾ inch (19 mm)
Effective cross sectional area	0.28 Sq. inches (181 mm^2) min 0.33 Sq. inches (213 mm^2) max.
Height of deformations	0.045 inches (1.14 mm) min. 0.060 inches (1.52 mm) max.
Weight per linear meter	1.15 lbs (1.71 kg) min. 1.35 lbs (2.01 kg) max.
Yield strength (min.)	34,000 lbs (151.2 kN) (0.2% offset or 0.7% extension under load)
Ultimate strength (min.)	40,000 lbs (177.9 kN)
Elongation, min. (20 bar diameters) or Elongation, min. (10 bar diameters)	4.0% 7.0%
Heat analysis: Phosphorus content (max.) Sulfur content (max.)	 0.040% 0.050%

All tension tests to be performed in accordance with AASHTO M 275M.

622.2.3.2.3: Properly documented certified mill test reports will be provided for each heat of steel thread bars. Mill test reports will document compliance with paragraph 622.2.3.2.1 or 622.2.3.2.2 as applicable.

622.2.3.2.4: All thread bars, anchor nuts, couplers and ancillary hardware shall be hot-dip galvanized to AASHTO M 111. Prior to galvanizing, thread bars shall be blast cleaned to Steel Structures Painting Council Surface Preparation Specification Number 6 (Commercial Blast Cleaning). Acid

pickling of thread bars will not be permitted. To provide for proper assembly after galvanizing, excess zinc shall be removed by machining using suitable thread taps and dies from the threads of nuts, couplings and thread-bars as necessary. Removal of excess zinc by heating will not be permitted.

622.2.3.3 - Timber Fasteners: Dome head drive spikes and washer head drive spikes noted on the Plans shall be Sealtite Dome Head Drive Spikes and Lewis Washer Head Timber Drive Spikes as manufactured by Lewis Bolt and Nut Company, Minneapolis, Minnesota, or as approved by the Engineer. Round head bolts noted on the Plans shall be metric round head square neck bolts (carriage bolts) meeting the requirements of ANSI/ASME Specification B18.5.2.2M. Dome head bolts noted on the Plans shall have a circular dome shaped head and shall meet the requirements of ASTM A 307, except head markings are not required. Hex head bolts shall be hex or heavy hex and shall meet ASTM A 307. 1¼ inches (30 mm) dome head bolts shall have a minimum head diameter of 3 inches (75 mm) and a minimum head height of 9/16 inch (14 mm). Nuts shall be hex or heavy hex meeting AASHTO M 291M or AASHTO M 292M. Round washers shall be Type A, Wide Series meeting the requirements of ASTM F 844. Washers noted on the Plans as "timber washers" shall be oversize in diameter and thickness, manufactured from cast or malleable iron, hot-dip galvanized and of a style and design typically used in heavy timber construction. Fluted steel dowels (spiral dowels) shall be as manufactured by Wadsworth Equipment Company, Akron, Ohio or as approved by the Engineer. All timber fasteners shall be hot-dip galvanized to meet AASHTO M 232M. Mill test reports, certifications or testing of above fasteners is not required. Acceptance will be based on visual inspection at the project site or at the fabricator's plant.

622.2.3.4 - Anchor Bolts at Abutments or Piers: Anchor bolts at bridge abutments or piers shall be ¾ inch (20 mm) diameter steel "all thread" rods meeting the requirements of ASTM A 307, hot-dip galvanized to AASHTO M 232M. Bolt length is governed by deck, timber or steel angle thickness and embedment in concrete as noted on the Plans. Nuts and washers shall be as specified in paragraph 622.2.3.3. Mill test reports, certifications or testing of anchor bolts, nuts or washers is not required. Acceptance will be based on visual inspection at the project site or at the fabricator's plant.

Anchor bolts in concrete are to be installed using Molly "Parabond" Capsule Chemical Anchor System as manufactured by Molly Fastener Group, 504 Mt. Laurel Avenue, Temple, Pennsylvania 19560, Telephone: (215) 929-5674, or Sup-R-Set Capsules Chemical Anchor System as manufactured by Gunnebo Fastening Corp., P.O. Box 1589, York, PA 17405, Telephone (717) 846-2200, or Rawl Chem-Stud #6500 as manufactured by the Rawl Plug Co., Inc., Two F.B. Powers Square, New Rochelle, NY, 10802, Telephone (914) 235-6300, or approved equal. Installation of anchor bolts is to be in accordance with the chemical capsule manufacturer's recommendations. The end of each anchor bolt is to be ground to the configuration recommended by

the chemical capsule manufacturer.

Certification or testing of chemical anchor system is not required.

622.2.3.5 - Split Rings, Shear Plates and Nails: Split rings shown or noted on the Plans shall be TECO Wedge - Fit Split Rings, Type M-2, as manufactured by TECO, Colliers, West Virginia or approved equal. Shear plates shown or noted on the Plans shall be TECO Shear Plates Type 143-D Galvanized, as manufactured by TECO, Colliers, West Virginia or approved equal. Split rings and shear plates shall be furnished hot-dip galvanized. Mill test reports, certifications or testing of split rings is not required. Acceptance will be based on visual inspection only.

Miscellaneous nails required during fabrication will be sized by the fabricator considering the intended function. Certification or testing is not required.

622.2.3.6 - Steel Beam Guardrail: Steel beam guardrail, fasteners and accessories, when specified on the Plans, shall be in accordance with AASHTO M 180, Type II, Class A, unless otherwise noted. All materials shall be supplied by companies which are included on the Division's list of Certified Suppliers of Guardrail and Associated Hardware.

The Contractor will be responsible for drilling additional holes in the rail, if required, to fit the post spacing shown on the Plans.

622.2.3.7 - Anchor Bolts For Guardrail and Diaphragm Fasteners: Anchor bolts connecting steel beam guardrail to wood guardrail shall meet AASHTO M 164M with appropriate nuts and washers, all hot-dip galvanized to AASHTO M 232M. Pipe sleeves at guardrail connection are to be DN25 standard galvanized steel pipe, schedule 40, and may be cut to specified length by pipe cutter or saw cut without repair of cut surface.

Lag screws and standard washers for installation of diaphragms between structural glued-laminated beams shall be standard hex head lag screws and standard mild steel washers all hot-dip galvanized to AASHTO M 232M.

Steel rods, threaded both ends, for installation of diaphragms and guard rail post supports to structural glued-laminated beams shall be manufactured from steel rod meeting AASHTO M 270M Grade 250 or AASHTO M 169 Grade 1018 thru 1045. Nuts and timber washers shall meet the requirements of Section 622.2.3.3. All materials shall be hot-dip galvanized to AASHTO M 232M.

Mill test reports, certifications or testing of anchor bolts, nuts, washers, lag screws or pipe sleeves is not required. Acceptance will be based on visual inspection at the project site or at the supplier's plant.

622.2.3.8 - Fabrication bars and accessories for modular construction: Fabrication bars shall be nominal ¾ inch (20 mm) O.D. all thread high strength steel bar with the following properties:

Nominal diameter	¾ inch (19 mm)
Yield Strength (min.)	34,000 lbs (151.2 kN)
(0.2% offset or 0.7% extension under load)	
Ultimate strength (min.)	40,000 lbs (177.9 kN)
Elongation, min. (20 bar dia.)	4.0%
or	
Elongation, min. (10 bar dia.)	7.0%
Chemical Analysis:	
Phosphorus content (max.)	0.040%
Sulfur content (max.)	0.050%

Tension tests shall be performed on full size samples in accordance with ASTM A 370. Threads shall be 10 Threads per inch (2.5 mm per thread) Unified Coarse Thread Series as specified in ANSI B1.1 and shall have Class 2A tolerances.

Nuts for use with fabrication bars shall be heavy hex series and shall meet AASHTO M 291M Grade C, D or DH, or shall meet AASHTO M 292M Grade 2 or 2H.

Bearing and anchor plates shall be carbon steel and shall meet AASHTO M 270M Grade 250.

All material supplied under this paragraph is to be plain, uncoated. Hot dip galvanizing is not required.

The Contractor will provide the Engineer with mill test reports or certifications from the material producers which indicate the materials supplied are in conformance with the referenced specifications.

622.2.3.9 - Aluminum Deck Bracket: Cast aluminum brackets connecting glulam deck panels to glulam stringers shall be of a design and dimensions as shown on the Plans and shall meet the requirements ASTM B 108 Alloy 356.0 Temper T6. The Contractor shall provide the Engineer with a letter of certification from the foundry producing the castings. Acceptance shall be based on the certification and visual inspection at the fabrication plant or on the project site.

622.2.4 - Preservative Treatment: Treatment of all sawn timber and lumber shall be by the Empty Cell process in accordance with the American Wood Preserver's Association (AWPA) Standard C2. Treating solution shall be Coal Tar Creosote conforming to AWPA Standard P1. Treatment retention shall be 7.0 pcf (112.1 kilogram per cubic meter (kg/m^3)) minimum and shall be determined by the gauge or weight method.

All lumber and timber members shall be dimensioned, cut, machined and

drilled prior to preservative treatment except stress-laminated deck lumber 2 inches (50 mm) or less in thickness, which can be drilled or cut to length after treatment. Deck lumber cut to length after pressure treatment shall have the saw cut ends treated in accordance with AWPA Standard M4. Holes in deck boards drilled to accept steel thread bars, to provide for void drains, or to attach guardrail and curbs do not require treatment of holes.

All surfaces shall be free of excess treatment solutions at the time of delivery to the job site.

622.2.5 - Elastomeric Bearing Pads: Elastomeric bearing pads shall be of the size and type shown on the Plans and shall conform to the AASHTO M 251 with a durometer hardness of 60.

622.2.6 - Structural Glued-Laminated Timber (Glulam): All structural Glued-Laminated Timber members shall be visually graded Southern Pine or visually graded Douglas Fir-Larch as shown on the drawings and specified below.

Materials, manufacture and quality control shall be in accordance with American National Standards Institute/American Institute of Timber Construction (ANSI/AITC) Standard A 190.1, Structural Glued-Laminated Timber, and shall provide allowable design values as shown on the Plans. All design values are based on wet condition of service. Adhesives shall meet the requirements of wet-use for wet conditions of service. Appearance of the members shall be industrial grade. Surfaces of members shall be not sealed and members shall not be wrapped. Members shall be marked with a Quality Mark and, in addition, a Certificate of Conformance shall be provided to the Engineer to indicate conformance with ANSI/AITC A 190.1, Structural Glued-Laminated Timber.

All Structural Glued-Laminated Timber members shall be preservative treated in accordance with AITC Standard 109, Standard for Preservative Treatment of Structural Glued-Laminated Timber and AWPA Standard C28, Standard for Preservative Treatment of Structural Glued-Laminated Timber. Treating solution shall be Coal Tar Creosote conforming to AWPA Standard P1. Treatment retention shall be 12.0 pcf (192.2 kilogram per cubic meter (kg/m^3)) minimum, and shall be determined by the assay method. Incising is required prior to treatment for members manufactured from Douglas Fir-Larch.

AT THE COMPLETION OF THE TREATING CYCLE, ALL STRUCTURAL GLUED-LAMINATED MATERIAL SHALL BE CLEANED BY FINAL STEAMING FOR 3 HOURS AT A TEMPERATURE BETWEEN 220° F (105° C) AND 240° F (115° C).

All surfaces shall be free of excess treatment solution at the time of delivery to the job site.

All Structural Glued-Laminated Timber members shall be dimensioned, machined, have holes bored and cut to proper length prior to preservative treatment except diaphragms for Type B and C bridges may be trimmed to length for up to 1 inch (25 mm) after treatment provided the trimming is

followed by re-treatment in accordance with AWPA Standard M4. Holes bored for lag screws for Type B and C bridges may be done after preservative treatment provided all holes are treated in accordance with AWPA Standard M4.

622.3 - QUALITY CONTROL:

622.3.1 - Contractor's Responsibility: The Contractor is responsible for control of the product through all manufacturing operations to assure that the completed work is in conformance with these specifications.

As required by paragraphs 622.2.1 and 622.2.2, all lumber and timber shall be graded, approved and stamped or tagged by a certified grader. The Contractor shall schedule, contract and otherwise arrange for the specified grading inspection. Cost of the inspection is to be included as incidental to the work. The Contractor will provide the Engineer suitable reports which document the acceptance of the lumber by the certified grader.

622.3.2 - Manufacturers of Structural Glued-Laminated Timber: All manufacturers of Structural Glued-Laminated Timber (Glulam) members shall be a "licensed laminator" by the AITC as required by ANSI/AITC Standard 190.1. A list of AITC licensed laminators can be obtained from the American Institute of Timber Construction, 11818 S.E. Mill Plain Boulevard, Suite 415, Vancouver, Washington 98684, Telephone (206) 254-9132 or (800) 525-1625.

622.3.3 - Wood Preserving Plant: The wood preserving plant shall comply in all respects with AWPA Standard M3, Standard Quality Control Procedures for Wood Preserving Plants. The quality control inspector's responsibilities and inspection procedures are to be in accordance with AWPA Standard M3, Standard Quality Control Procedures for Wood Preserving Plants and AWPA Standard M2, Standard for Inspection of Treated Lumber Products. The quality control inspector shall conduct all inspections and tests and maintain all records and reports required by the above mentioned AWPA Standards and shall provide copies to the Engineer. Upon completion of all treating operations the treater will also supply a Certificate of Compliance as required by paragraph 7.1 of AWPA Standard M3.

622.3.4 - Division's Inspection: The Division shall conduct routine inspections of all laminating, manufacturing, sawing, machining, grading and treating operations to assure the Contractor is complying with the specification requirements. Where deficiencies in material or procedures are noted by the Division inspector, the Contractor shall take immediate steps to correct the deficiency. Any materials found defective or deficient will be rejected and shall be replaced with acceptable material at no cost to the Division.

622.4 - SHOP AND ERECTION DRAWINGS:

The Contractor shall submit to the Engineer, in the required number of copies, a complete set of shop and erection drawings as required by Section 105.2 of the Standard Specifications. The drawings shall consist of such detail Plans as may be reasonably required for the successful completion of the work. Shop drawings shall include detailed dimensions and arrangement of the stress-laminating system, deck lumber dimensions including joint locations where full length boards are not utilized, full dimensions and bolting layout of the curb and guardrail when specified, and all bearing details. Shop drawings shall also include details of all Structural Glued-Laminated Timber members.

Upon completion of all fabrication operations and shipment of all material to the project site the Contractor shall forward to the Engineer a complete set of as-built shop drawings in reproducible quality (Mylar or equivalent). The set will consist of the latest revisions of each individual shop drawing that has been previously submitted and approved by the Engineer.

All drawings shall be submitted to the Engineerfor approval a minimum of two (2) weeks prior to the start of fabrication. All dimensions shall be in metric units only.

CONSTRUCTION METHODS

622.5 - CONSTRUCTION METHODS:

Stress-laminated and structural glued-laminated timber bridges are to be fabricated and erected in accordance with the Plans and these specifications.

622.5.1 - Handling: Treated timber shall be carefully handled without sudden dropping, breaking of outer fibers, bruising, or penetrating the surface with tools. Treated members shall be handled with web slings. Cant hooks, peaveys, pikes, cables, chains or hooks shall not be used. When metal bands are used to bundle members, corner protectors shall be provided to prevent damage. Structural glued-laminated beams shall be tipped and lifted on edge using web slings at as many points as necessary to prevent damage. Steel spreader beams shall be utilized to prevent eccentric loading of long members. Glulam plank deck panels may be lifted flat using fabricated steel C-shaped brackets that fit over the member ends. The contractor has complete responsibility for utilizing proper shipping and handling techniques. Any damage shall be repaired or replaced to the satisfaction of the Engineer at no additional cost.

622.5.2 - Stress-Laminated Deck Assembly: Stress-laminated decks may be prefabricated at a manufacturing or fabrication facility. The full width or sections of the deck may be prefabricated and stressed, or panels may be fabricated, joined and stressed in the field.

If decks are fabricated in sections and stressed using bearing plates under the thread bar coupler, the bearing plates must be removed after all sections have been joined.

622.5.3

Butt joints are permitted in the lamination provided: a) Lamination length is not less than 4 ft (1200 mm); b) No butt joints are located within a distance equal to the deck thickness from a stressing bar, and; c) No more than one butt joint occurs in any five adjacent laminations within a distance of 2 ft (600 mm). The joint layout is to be shown on the shop drawings.

Gaps between butt ends of deck boards shall be 1 inch (25 mm) or less. The height differential between adjacent deck boards shall be ¾ inch (20 mm) or less.

Holes for stressing bars shall be large enough to allow a barwith a coupler, if used, to be removed from the stressed deck, but shall not exceed 20% of the width of the board, but may be 1¾ inch (45 mm) maximum on a 7 inches (175 mm) board.

Holes into the deck for attaching the deck to the substructure and for attaching curbs and posts to the deck shall not be drilled until after Stage 2 of the stressing procedure is completed. Holes in the substructure shall not be drilled until the deck is in place and after Stage 2 of the stressing procedure is completed.

622.5.3 - Stressing: Stressing bars shall be tensioned with a hydraulic jack. The jack shall be calibrated at least yearly to provide an accurate indication of load.

Stressing bars shall be tensioned to the specified load shown on the Plans. Stressing shall be done in accordance with the following procedure:

Stage 1: Load each bar to 50 percent of the specified load using a bar stressing sequence which will prevent distortion and maintain a uniform bridge (panel) width for the full length of the bridge. Repeat using the full specified load until all bars are properly tensioned.

Stage 2: A minimum of five (5) days but not more than seven (7) days after the completion of Stage 1, reload all bars to the specified load.

Stage 3: A minimum of four (4) but not more than six (6) weeks after the completion of Stage 2, reload all bars to the specified loads shown on the Plans.

During the stressing procedure, the load in the first bars that were stressed will most likely decrease as the other bars are stressed. In all three (3) stages, after the Contractor is satisfied that all bars are stressed to the proper load, Contractor shall return to the first three (3) full width bars that were stressed and verify on the hydraulic stress gauge that all three (3) maintained a minimum of 90% of the specified load. If any of the first three (3) full width bars did not maintain at least 90% of the specified load, all the bars on the bridge shall be stressed again. The checking of the first three (3) full width

bars and subsequent stressing of all bars shall be repeated until they maintain at least 90% of the specified load.

The Engineer shall be notified at least two (2) days prior to beginning each stressing stage.

No vehicles shall be allowed on the bridge until the completion of Stage 2 stressing.

622.5.4 - Camber: An upward curve or camber shall be provided in each bridge as noted on the Plans. The camber shall be a uniform curve in the length of the bridge and shall show maximum offset at the approximate center of the span. Camber shall be consistent across the bridge width and measurement shall be made at both edges and the centerline.

622.5.4.1 - Type A Bridges: When the full bridge width, or sections, are prefabricated and stressed at the fabrication facility, the fabricator shall introduce sufficient initial camber, prior to stressing, so that under full dead load the final camber will be as specified. When panels or individual members are delivered loose, they shall be erected over a temporary support to induce the required camber across the full width of the bridge and shall be adjustable so that it can be lowered to allow full dead load on the bridge, or can be raised to induce additional camber should it become necessary.

If 75% of the final camber is not provided under full dead load the Contractor shall support the structure on a temporary support, loosen all stressing bars, induce additional camber by raising the support, re-stress all bars and lower support to verify proper camber.

622.5.4.2 - Type B, C, D and E Bridges: Structural Glued-Laminated Timber members shall be manufactured with the camber shown on the Plans. The camber specified is with no load on the member.

622.5.5 - Modular Construction: When specified on the Plans the bridge will be fabricated and erected using modular techniques as described below. The applicable provisions of 622.5.1 through 622.5.4 also apply to modular fabrication and erection.

Modular construction does not apply to Type D and E bridges.

622.5.5.1 - Module Assembly: Each module shall consist of the appropriate number of rows of individual deck planks so when mated to the exterior glued-laminated beams the total module width will be as noted on the Plans after the third stressing. The Contractor is responsible for including as many additional rows of deck planks as may be necessary to compensate for lumber compression or shrinkage thru all three stages of stressing.

The deck planks shall be assembled with the two module beams using jigs, pipe guides and nails or other means so that proper alignment and beam camber can be maintained prior to inserting stressing bars. After the two beams and rows of deck planks are properly assembled, steel thread bars meeting the

requirements of 622.2.3.2, except the bars need not be coated, shall be inserted in all 2 ft (600 mm) center holes. Stage 1 stressing shall be performed before each module is moved from the assembly jig or the module is handled in any manner. Handling of modules is to be in accordance with 622.5.5.4. In addition, high strength steel fabrication bars meeting the requirements of 622.2.3.8 shall be inserted in all 6 ft (1800 mm) center holes. The 2 ft (600 mm) center bars can be removed before shipping from the fabrication shop and must be removed before the modules are erected on the project site. The fabrication bars on 6 ft (1800 mm) centers will remain permanently in the bridge, except for the exterior (fascia) modules where the bars shall be removed after completion of the field stressing operation. Galvanized bearing plates shall be used on the outside of the fascia modules for all 2 ft (600 mm) center bars. All other bearing plates may be uncoated.

The Contractor is responsible for maintaining the squareness of each module. This may require additional diaphragms, stressing rods, braces, etc. either temporary or permanent. All materials required for this purpose shall be clearly shown on the shop drawings and shall be noted as either temporary or permanent. Materials noted as permanent shall meet all quality requirements of this specification. Attachment of temporary materials shall be such that the preservative envelope of the bridge members is not damaged in any way. Holes in structural glued-laminated members shall be bored prior to preservative treatment and temporary holes shall be filled with treated wood plugs to the satisfaction of the Engineer. Regardless of the method chosen by the Contractor to control module squareness, each completed and fully stressed module at any cross-section throughout its length shall not be out-of-square by more than 1/8 inch (1 mm) per ft (100 mm) of web depth when measured at the top or bottom outer surface of either module web. No more than 0.01 inch (1 mm) of sweep, measured at the module centerline, is allowed per ft (1000 mm) of length. When fully assembled, no more than 0.03 inch (3 mm) of sweep, measured at the bridge centerline is allowed per ft (1000 mm) of length. When fully assembled the bridge width shall be at least as wide as the plan dimension but not more than 1½ inches (40 mm) wider than the plan dimension at any point. No separate payment will be made for these additional materials or labor used to control module squareness. Cost to be included in the unit price for the fabricated bridge members.

622.5.5.2 - Shop Module Stressing: All steel thread bars in the 2 ft (600 mm) center holes shall be stressed to the load shown on the Plans. All three stages of stressing shall be performed in the fabrication shop. Upon completion of each stage of stressing, the hex nuts on the fabrication bars on 6 ft (1800 mm) centers shall be fully tightened using the full effort of a man on an ordinary spud wrench.

622.5.5.3 - Curbs, Guardrail Posts and Diaphragms: Curbs and guardrail posts for Type A bridges shall be shop installed after the second stressing and at any phase for Type B or C. Diaphragms shall beshop installed

after the third stressing. Diaphragms and end blocks shall be fabricated such that a maximum gap of 3/16 inch (5 mm) exists between each side of the diaphragm or end block and the webs of the beams. Some trimming to length of the diaphragms may be necessary to compensate for the loss of module width due to stressing. See 622.2.6 for treating requirements after trimming to length.

622.5.5.4 - Handling, Shipping and Erection: As each module is assembled in the fabrication shop, a handling and erection lifting ring system shall be installed after the Stage 1 stressing. Details of the lifting ring system are shown on the Plans. All handling of the modules shall be performed using the lifting rings. Use of fork lifts under the modules, slings, choker cables, grab hooks, etc. is prohibited.

Two (2) days after the Stage 3 stressing is completed, the bars on 2 ft (600 mm) centers (not the bars on 6 ft (1800 mm) centers) can be removed, or, all the bars can remain in for shipping. If the Contractor elects to leave all bars in place for shipping, the bars on 2 ft (600 mm) centers must be removed prior to erection. After the Stage 3 stressing and prior to erection, the fabrication bars on 6 ft (1800 mm) centers shall be saw cut off flush with the face of the hex nut, except for the bars on the fascia side of the exterior module which can remain long to facilitate removal of the fabrication bars after erection.

The first module should be positioned on the abutments as precise as possible and secured to the bridge seat. Careful alignment of the remaining modules will facilitate installation of the full width stressing rods.

The modules shall be stressed together after inserting stressing rods and placement of bearing plates. Only one stressing operation is required in the field, although several passes over all the bars may be required to meet the 90% load requirement of 622.5.3.

Upon completion of erection, the fabrication bars in the fascia modules shall be removed and the holes plugged with a treated wood plug.

The handling and erection lifting ring system components shall be removed and will remain the property of the Contractor. Cost of the lifting ring system is considered incidental to Item 622020-*, Stressing Hardware. Holes in the stressed deck shall be plugged with treated wood plugs.

Field nailing to any treated bridge component is prohibited.

622.5.6 - Backwall Installation: Backwalls shown on the Plans shall not be placed until after completion of erection of all superstructure components. The end of the bridge members may be used as a form for placement of concrete backwalls provided the preformed joint filler is suitably secured to the bridge. The end diaphragms may require additional bracing or blocking to prevent damage from use as a concrete form. The Contractor is responsible to provide the necessary additional support and will repair any damage to the satisfaction of the Engineer.

622.6 - METHOD OF MEASUREMENT:

622.6.1 - Stress-Laminated Timber Bridge Fabricated and Installed:

The quantity of work done will be measured in 1,000 ft board measure (Mfbm)(cubic meter (m^3)) as established in the proposal which is based on actual plan sizes of all lumber and timber including structural glued-laminated timber shown on the Plans, and shall include bearings and bearing pads if specified, preformed joint sealer, hot-poured joint sealer, timber connectors and all necessary hardware, except stressing hardware and steel beam guardrail, complete in place and accepted in the finished structure for the structure type noted on the Plans.

Stressing hardware will be measured as a separate item.

Steel beam guardrail and hardware will be measured as Section 607 Items.

622.6.2 - Stress-Laminated Timber Bridge Fabricated and Delivered:

The quantity of work done will be measured in 1,000 ft board measure (Mfbm)(cubic meter (m^3)) as established in the proposal which is based on actual plan sizes of all lumber and timber including structural glued-laminated timber shown on the Plans, and shall include bearings and bearing pads if specified, timber connectors and all necessary hardware, except stressing hardware and steel beam guardrail, and delivered in the manner and to the site set forth in the contract documents for the structure type noted on the Plans.

NOTE: Stressing hardware will be measured as a separate item.

622.6.3 - Structural Glued-Laminated Timber Bridge Fabricated and Installed: The quantity of work done will be measured in 1,000 ft board measure (Mfbm)(cubic meter (m^3)) as established in the proposal which is based on actual plan sizes of all structural glued-laminated members and other timber components as shown on the Plans, and shall include bearings and bearing pads if specified, preformed joint sealer, hot-poured joint sealer, timber connectors and all necessary hardware, except steel beam guardrail, complete in place and accepted in the finished structure for the structure Type noted on the Plans.

Steel beam guardrail and hardware will be measured as section 607 Items.

622.6.4 - Structural Glued-Laminated Timber Bridge Fabricated and Delivered: The quantity of work done will be measured in 1,000 ft board measure (Mfbm)(cubic meter (m^3)) as established in the proposal which is based on actual plan sizes of all structural glued-laminated members and other timber components as shown on the plans, and shall include bearings and bearing pads if specified, timber connectors and all necessary hardware, except steel beam guardrail, and delivered in the manner and to the site set forth in the contract documents for the structure Type noted on the Plans.

622.6.5 - Timber Substructure: The quantity of work done will be measured in 1,000 ft board measure (Mfbm)(cubic meter (m^3)), computed on the basis of actual plan sizes of all lumber and timber members shown on the Plans, and shall include all necessary hardware complete in place and accepted

in the finished structure.

622.6.6 - Stressing Hardware: The quantity of work for "Stressing Hardware" will be measured and paid for as lump sum. Stressing hardware includes stressing bars, plates, nuts, handling and erection lifting ring system components and any other hardware related to the stressing of the timber.

For 622.6.1 "Stressing Hardware" shall include the initial stressing and restressing at five (5) days and four (4) weeks.

For 622.6.2 "Stressing Hardware" shall include all material delivered in the manner and to the site set forth in the contract documents. When modular construction is specified, "Stressing Hardware" shall also include the initial stressing and restressing at five (5) days and four (4) weeks.

622.7 - BASIS OF PAYMENT:

The quantities, determined as provided above, will be paid for at the contract unit prices bid for the items listed below, which prices and payments shall be full compensation for furnishing all the materials, except as above noted, and doing all the work herein prescribed in a workmanlike and acceptable manner, including all labor, tools, equipment, supplies, and incidentals necessary to complete the work.

622.8 - PAY ITEMS:

ITEM	DESCRIPTION	UNIT
622005-*	STRESSD TIMBER BRIDGE, TYPE A, FABRICATED AND INSTALLED	THOUSAND BOARD FOOT (CUBIC METER)
622006-*	STRESSED TIMBER BRIDGE, TYPE A, FABRICATED AND DELIVERED	THOUSAND BOARD FOOT (CUBIC METER)
622007-*	STRESSED TIMBER BRIDGE, TYPE B, FABRICATED AND INSTALLED	THOUSAND BOARD FOOT (CUBIC METER)
622008-*	STRESSED TIMBER BRIDGE, TYPE B, FABRICATED AND DELIVERED	THOUSAND BOARD FOOT (CUBIC METER)
622009-*	STRESSED TIMBER BRIDGE, TYPE C, FABRICATED AND INSTALLED	THOUSAND BOARD FOOT (CUBIC METER)
622010-*	STRESSED TIMBER DECK, TYPE C, FABRICATED AND DELIVERED	THOUSAND BOARD FOOT (CUBIC METER)
622011-*	STRUCTURAL GLUE-LAMINATED TIMBER BRIDGE, TYPE D	THOUSAND BOARD FOOT (CUBIC METER)
622012-*	STRUCTURAL GLUE-LAMINATED TIMBER BRIDGE, TYPE D, FABRICATED AND DELIVERED	THOUSAND BOARD FOOT (CUBIC METER)
622013-*	STRUCTURAL GLUE-LAMINATED TIMBER BRIDGE, TYPE E,	THOUSAND BOARD FOOT (CUBIC METER)
622014-*	STRUCTURAL GLUE-LAMINATED TIMBER BRIDGE, TYPE E	THOUSAND BOARD FOOT (CUBIC METER)
622019-*	TIMBER SUBSTRUCTURE	THOUSAND BOARD FOOT (CUBIC METER)
622020-*	STRESSING HARDWARE	LUMP SUM

*Sequence number